Past tense and past participle verb use in young children with and without Specific Language Impairment

By

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Abstract

Finiteness marking is an area of weakness in specific language impairment (SLI) and two hypotheses attempt to account for this difficulty. The Extended Optional Infinitive (EOI) account proposes that SLI children have difficulties with the morphosyntactic properties of verbs. The surface account proposes that SLI children have difficulties with the surface properties of morphophonology. In English, the regular past participle provides an interesting test case for these hypotheses – it is not marked for finiteness, yet is homophonous with the regular past tense. Thus, children's use of regular past participles offers a window to explore further the source of the weakness in regular past tense marking. Previous studies yield inconclusive outcomes for regular forms and do not explicitly compare irregular forms.

This study aimed to address the inconsistency in the literature by comparing regular past tense and regular past participle accuracy longitudinally, and explicitly comparing irregular past tense and irregular past participle accuracy. Participants included 65 SLI children (*M* = 5;5), 59 age-equivalent (AE) controls (*M* = 5;6), and 32 language-equivalent (LE) controls (*M* = 3;3). Two spontaneous language samples were collected approximately one year apart.

At Time 1, SLI children were less accurate on the regular past participle than both AE and LE controls, but did not differ at Time 2. At Times 1 and 2, SLI children did not differ from AE controls on the irregular past participle. At Time 1, SLI children were more accurate on the regular past participle than the regular past tense, but did not differ at Time 2. Contrastingly, SLI children were more accurate on the irregular past participle than the irregular past tense at Times 1 and 2.

As predicted by the EOI account, the past tense is more difficult than the past participle for SLI children irrespective of form. For SLI children, the past participle is easier than the past

tense, with the irregular past participle conferring a greater advantage than the regular past participle. In general, the results are consistent with previous reports on homophonous forms and highlight the importance of age at time of assessment when evaluating group differences.

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Introduction

Specific language impairment (SLI) is a disorder characterized by impairments in grammar in the absence of hearing loss and any other cognitive impairment. Although young children with SLI demonstrate particular weaknesses in some properties of grammar, they also demonstrate closely related strengths. For example, children with SLI are shown to have difficulty mastering the third person singular present tense affix *–s* (e.g., she *runs* home), yet are not shown to have the same difficulty mastering the plural affix *–s* (e.g., the *dogs* play outside) (Rice & Oetting, 1993). Although the third person singular present tense affix *–s* and the plural affix *–s* share the same surface properties making them morphophonologically similar, they have different underlying representations and are thus morphosyntactically different.

Children with SLI are also shown to have difficulty with specific functions of DO (Rice & Blossom, 2013). DO is plurifunctional and takes on several different roles in English, including serving as a main verb and as an auxiliary verb preceding a main verb (Quirk, Greenbaum, Leech, & Svartvik, 1985). In their 2012 study, Rice and Blossom demonstrated that children with SLI have a particular difficulty with marking DO for finiteness in finiteness-required contexts. Crucially, this difficulty was observed for auxiliary DO, but not main verb DO. Their results indicate that children with SLI acquire the multiple functions of DO separately and that the grammatical properties of DO determine whether or not it will pose a difficulty to children with SLI.

Research contrasting accuracy levels on the third person singular present tense affix *–s* and the plural affix *–s* and accuracy levels on the different functions of DO parallels another area of inquiry – the study of regular past tense and regular past participle use in children with SLI.

These forms share the same surface properties, yet like the different functions of DO, have different underlying representations. For example, contrast the following sentences:

(1) Henry *walked* home. (where *walked* = walk + *–ed*; regular past tense)

(2) Henry had *walked* home. (regular past participle)

In (1), the regular past tense verb *walked* is marked for finiteness, an area of grammar where English-speaking children with SLI show a particular weakness (Conti-Ramsden, Botting, & Faragher, 2001; Leonard, Bortolini, Caselli, & McGregor, 1992; Oetting & Horohov, 1997; Rice & Wexler, 1996; Rice, Wexler, & Cleave, 1995; Rice, Wexler, & Hershberger, 1998). However in (2), finiteness is already marked on the auxiliary *had* and is therefore not marked on the past participle *walked*. For example, if present tense is intended, the change appears in the use of *has* for *had*, not *walks* for *walked*. Thus, the regular past tense affix *–ed* in (1), although morphophonologically similar, is morphosyntactically different than the regular past participle affix *–ed*. As a result, contrasting accuracy levels on the regular past tense and the regular past participle in children with SLI offers a window to explore further the source of the weakness in past tense marking.

Past Tense and Past Participle Structure

Like the multiple functions of DO, the regular past tense and the regular past participle share the same surface properties; however, finiteness marking is site-specific and is indicated by the affix *–ed* on regular past tense verbs. Contrastingly, the regular past participle is not marked for finiteness, yet is morphophonologically similar (i.e., homophonous) with the regular past tense forms of verbs. Consider (1) and (2) again. Within the minimalist framework of Chomsky (see Chomsky, 1993), simple clauses contain both a noun phrase (NP) and a verb phrase (VP).

Main verbs, such as *walk*, carry tense (TNS) and agreement (AGR) features that must be checked in a higher projection called the inflectional phrase (IP) where finiteness marking takes place. In (1), *Henry*, the grammatical subject, moves from the specifier (Spec) position of VP to the Spec of IP position. The main verb, in this case *walk*, moves from the V position to the I position where both its TNS and AGR features are checked (i.e., *walk* becomes *walked*; where *walked* = walk + *–ed*). Contrastingly, the past participle does not carry TNS and AGR features that need to be checked as finiteness marking already takes place on the preceding auxiliary *had*, thus, movement to the I position does not occur.

Figure 1: *Diagram of Past Tense Movement*

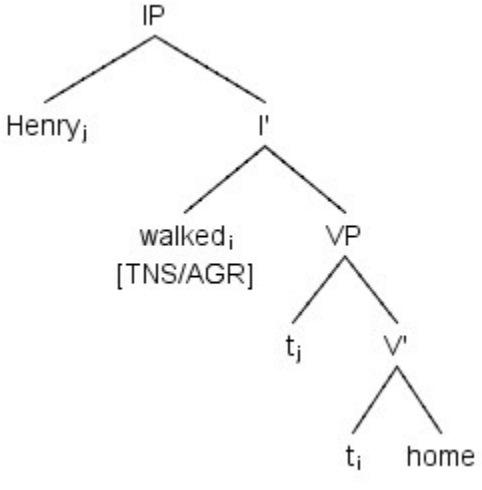
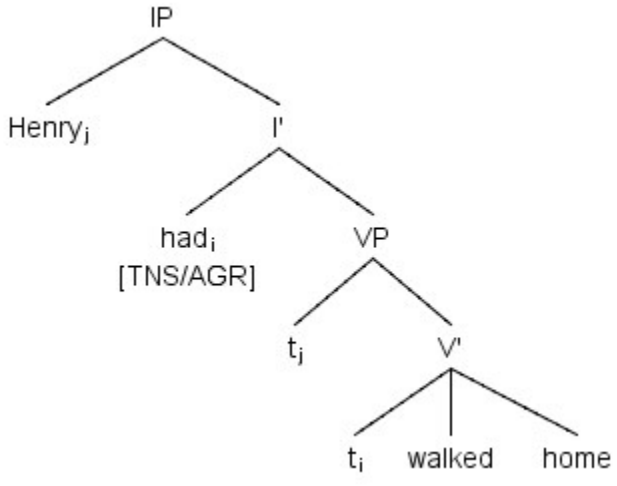


Figure 2: *Diagram of Past Participle*



Consider the impermissibility of *have* as an unmarked auxiliary preceding the past participle in (3) for further evidence that it is the auxiliary and not the past participle *walked* that is marked for finiteness:

(3) *Henry have *walked* home. (regular past participle)

Also, consider that past participles occur with some, but not all, auxiliaries:

(4) Henry was *chased* by the cat. (auxiliary BE)

(5) Henry had *chased* the cat. (auxiliary HAVE)

(6) *Did Henry *chased* the cat? (auxiliary DO)

Finally, consider the morphophonologically different forms in (7) and (8) for the irregular past tense and the irregular past participle as evidence of the different underlying representations of the past tense and past participle forms:

(7) Henry *broke* the vase. (irregular past tense)

(8) Henry had *broken* the vase. (irregular past participle)

Past Participles

As noted previously, the regular past participle is homophonous with the regular past tense. Contrastingly, irregular verbs can have a number of different forms; however, like regular verbs, most irregular verbs have a common past tense and past participle form (Quirk et al., 1985). Refer to Table 1, reproduced from Quirk et al. (1985), for a summary of irregular past tense and irregular past participle verb forms.

Table 1: *Irregular Past Tense and Irregular Past Participle Verb Forms*

	Base Form	Past	Participle
All three forms alike	cut	cut	cut
Past = Participle	meet	met	met
Base Form = Past	beat	beat	beaten
Base Form = Participle	come	came	come
All three forms different	speak	spoke	spoken

Past tense verbs are used in simple main clauses (e.g., the dog *scared* the cat) while past participles are a part of complex phrases that consist of two or more words (e.g., the dog *was scared* by the cat). The basic types of constructions that include past participles are perfectives and passives. The following verb phrases are largely outlined in Quirk et al. (1985): Perfectives consist of the auxiliary HAVE + past participle (e.g., the dog *had scared* the cat yesterday). Passives consist of the auxiliary BE + past participle (e.g., the cat *is scared* by the dog). Children also use *got* passives quite productively (e.g., the cat *got scared* by the dog). Past participles may also occur in combination with modal auxiliaries (e.g., the dog *may have scared* the cat; the cat *may be scared* by the dog), other past participles (e.g., the dog *has been scared* by the cat), progressive participles (e.g., the cat *is being scared* by the dog), modals + perfectives (e.g., the cat *may have been scared* by the dog), modals + progressives (e.g., the cat *may be being scared*

by the dog), perfectives + progressives (e.g., the cat *has been being scared* by the dog), and modals + perfectives + progressives (e.g., the cat *may have been being scared* by the dog) (Quirk et al., 1985). While past participles occur with auxiliary BE and auxiliary HAVE, past participles do not occur with emphatic or auxiliary DO (e.g., *the dog *did scared* the cat; **did* the dog *scared* the cat). Past participles can also occur as postmodifying participles as well (e.g., he *lives* in a place *called* Oz).

Comparing accuracy levels on both the regular past tense and the regular past participle, and the irregular past tense and the irregular past participle offers a window to explore further the source of the weakness in past tense marking.

Finiteness Marking Development in SLI

English-speaking children with SLI show a particular weakness in finiteness marking and this phenomenon is well attested for both the regular and irregular past tense (Leonard, 1998; Leonard, Bortolini, et al., 1992; Redmond & Rice, 2001; Rice, Wexler, Marquis, & Hershberger, 2000; Rice, Wexler, & Redmond, 1999). Children with SLI tend to omit finiteness marking and produce bare stem verbs in obligatory finiteness marking contexts above and beyond those produced by both age- and language-equivalent controls (Rice et al., 1998; Rice et al., 2000). Children with SLI continue to show a relative delay in their mastery of finiteness marking on past tense verbs through the early school years (Rice et al., 1998; Rice et al., 2000).

Two hypotheses attempt to account for this difficulty. The Extended Optional Infinitive (EOI) account proposes that children with SLI have difficulties with the morphosyntactic properties of the verb (i.e., children with SLI have difficulties with the grammatical properties of the verb). Alternatively, the surface account proposes that children with SLI have difficulties

with the surface properties of morphophonology (i.e., children with SLI have difficulties with the perceptual qualities of the affix).

The EOI account of Rice and Wexler proposes that children with SLI experience a prolonged period of not obligatorily marking tense in main clauses (Rice et al., 1995). This proposal is grounded in the Optional Infinitive (OI) account discussed in Wexler (1994), where it was shown that children sometimes use infinitive forms of verbs where finite forms are obligatory. Although children optionally omit obligatory finiteness marking in main clauses, they "show knowledge of the related linguistic processes that apply to finite verbs" (Rice et al., 1995). Typically developing children will emerge from the OI stage at around five years of age; however, for children with SLI, difficulties with finiteness marking can persist beyond adolescence (Rice, Hoffman, & Wexler, 2009). Crucially, in English, infinitive forms are homophonous with null finite forms of verbs; however, the OI/EOI accounts take the presence of omitted finiteness marking as evidence that English-speaking children are using infinitive forms of verbs in main clauses. To illustrate, consider:

(9) Henry *wants* candy. (where *wants* = want + –*s*; finite form)

(10) *Henry *want* candy. (omitted finiteness marking; infinitive form)

(11) I *want* candy. (where *want* = want + -∅; null finite form[1])

For all children, the EOI account predicts errors of omission to be the primary error in finiteness-required sites in clauses, irrespective of regular/irregular morphology. Importantly, omissions are restricted to finiteness-required sites in clauses. Finally, note that under the EOI account, overregularizations of irregular forms are treated as errors of morphophonology and can

[1] Contrast "I want candy" and "She wants candy" with "I do want candy" and "She does want candy" (where *want* = infinitival *want*, and finiteness is marked on emphatic DO).

be counted as attempts at finiteness marking (e.g., Henry *runned* home; where *runned* is considered an attempt at finiteness marking).

The surface account of Leonard proposes that children with SLI have difficulties perceiving and fully processing grammatical morphemes (Leonard, Eyer, Bedore, & Grela, 1997; Leonard, McGregor, & Allen, 1992). As a result of this general processing constraint, the surface account predicts that children with SLI will have difficulties with weak, unstressed morphemes. Incomplete processing of grammatical morphemes can lead to incorrect analyses of bare stems (Leonard et al., 1997). Furthermore, this hypothesis posits that SLI children's limited general processing abilities are particularly challenged when such weak, unstressed morphemes "play a morphological role" (Leonard et al., 1997). Like the EOI account, the surface account predicts errors of omission, but only for regular past tense verbs; however, such omissions result from general processing constraints and are not limited to finiteness marking sites in clauses. Irregular verbs are not predicted to be problematic for children with SLI as irregular past tense forms differ from irregular present tense forms "at least in a stressed vowel" (e.g., thr*o*w – thr*e*w) (Leonard et al., 1997).

Previous research has compared accuracy levels on the regular past tense and the regular past participle; however, these studies yield inconclusive outcomes for regular forms and do not explicitly compare irregular forms.

Previous Studies

Leonard and colleagues (2003) compared performance on the regular past tense and the regular past participle in children with SLI and age- and language-equivalent controls. Two sentence completion tasks were used – one requiring children to use past tense verb forms and one requiring children to use past participle verb forms. During the tasks, children played with an

examiner who provided descriptions of actions, using either the past tense or the past participle form of a verb. After being provided the subject for the target action (e.g., Cookie Monster), children were asked to produce the remainder of the sentence using the target verb and form (e.g., pushed the train). Note that in the past participle task, children were required to produce the accompanying *by*-phrase in order to earn credit for a correctly used past participle (e.g., got kissed *by the kitty*).

Results from Leonard and colleagues' study indicated that children with SLI were significantly less accurate in their performance than both age- and language-equivalent controls on both the regular past tense and the regular past participle. Furthermore, children with SLI were significantly less accurate in their performance on the regular past tense than the regular past participle. Although irregular past tense verbs and irregular past participles (*-(e)n* participles) were included in the tasks, they were done so as a methodological control (i.e., to serve as evidence that children could distinguish the two forms). There was no significant difference in performance between the children with SLI and the language-equivalent controls on the past participles requiring *–(e)n* as the inflected form.

Results from Leonard and colleagues' study demonstrate that although children with SLI are significantly less accurate on the regular past tense as they are on the regular past participle, they still show a particular weakness in the regular past participle relative to age- and language-equivalent controls. SLI children's differing use of the affix *–ed* suggests that it is not only the surface properties of the affix, but also the grammatical properties of the verb that affects performance (Leonard et al., 2003). Such results are consistent with the EOI account, although not specifically predicted. However, as Leonard and colleagues discussed, the surface account is unable to explain the finding that children with SLI were less accurate on past tense verbs

relative to past participle verbs while the language-equivalent controls preformed similarly on the two forms. As highlighted by Leonard and colleagues, the surface account predicts that if the language-equivalent controls preform similarly on the two forms, then the children with SLI should also preform similarly (although the SLI children would have a lower level of accuracy overall).

In another study, Redmond (2003) investigated children's productions of the affix *–ed* in past tense and past participle contexts. Spontaneous language samples and elicitation probes were used to assess children's performance on past tense and past participle verbs. The spontaneous samples were collected while an examiner interacted with children during a period of free-play. Examiners used specific strategies to encourage the obligatory contexts for regular past tense and regular past participle verbs. The elicitation probes for both the regular past tense and the regular past participle included the same set of verbs, which could be alternated naturally (e.g., cleaned, kicked). Children were presented with two pictures, one after the other, depicting an ongoing action and then the completed action. Children were asked to describe the completed action following different models for the different forms. For the participle targets, children were also required to include the obligatory auxiliary, which included *have*, *got*, or a form of BE.

Results from the spontaneous samples and elicitation probes indicated that children with SLI do not exhibit a weakness in marking regular participle forms within obligatory contexts. Rather, children with SLI performed similarly to the typically developing age- and language-equivalent controls. Contrastingly, children with SLI displayed a particular weakness in the regular past tense relative to both age- and language-equivalent controls. No comparison was made within groups for their performance on the regular past tense versus the regular past participle as was completed in Leonard et al. (2003).

Across Leonard and colleagues' and Redmond's studies, children with SLI were shown to have a greater difficulty with regular past tense targets than regular past participle targets. The important difference between the two studies concerns the regular past participle where in Leonard et al. (2003), children with SLI produced significantly fewer correct past participles than age- and language-equivalent controls while in Redmond (2003), children with SLI were shown to perform similarly to age- and language-equivalent controls on the regular past participle. This discrepancy in the findings warrants further study. Furthermore, while these studies sought to investigate the regular past participle in children with SLI, much less is known about the irregular past participle. Leonard et al. included irregular past participles with *–(e)n* inflections as a methodological control; however, there are several other classes of irregular past participles to be studied.

Limitations of Previous Studies

Leonard and colleagues' study included 36 children, 12 SLI, 12 age-equivalent, and 12 language-equivalent children. Although the SLI children had a mean age of 5;6, they ranged in age from 4;6 to 6;10. Furthermore, there was overlap in the range of ages between the SLI group and its language-equivalent group, which ranged in age from 2;8 to 4;11. There was also considerable overlap in MLU between the SLI and age-equivalent groups. The SLI group's MLU ranged from 3.48 to 5.26 and the age-equivalent group ranged from 4.61 to 5.86. Such overlaps could affect the validity of the results.

Redmond's study included 21 children, 7 SLI, 7 age-equivalent, and 7 language-equivalent children. Although the SLI children had a mean age of 6;1, they ranged in age from 5;4 to 6;10. Furthermore, two children with SLI tested within normal range on the omnibus language test (*Test of Language Development – Primary*). There was also considerable overlap

in MLU between the SLI and age-equivalent groups. The SLI group's MLU ranged from 3.29 to 5.39 and the age-equivalent group ranged from 4.13 to 5.62. Such an overlap could affect the validity of the results.

The constructions tested/elicited in Leonard et al. (2003) only included past participles preceded by *got* and auxiliary BE. Responses that did not include the *by*-phrase (e.g., was carried *by the bear*) were excluded from the scoring. The effect of the exclusion of otherwise correctly formed past participle constructions due to an omitted *by*-phrase is unclear. Leonard et al. found that 7 of the 9 participles (78%) contained the affix *–ed*, which they took to be in line with the accuracy levels observed for the scoreable responses; however, mean accuracy for the children with SLI on past participles was 53% (*SD* = 36%) while the mean accuracy for the language-equivalent controls was approximately 82% (*SD* = 20%). Thus, the accuracy of the excluded past participles appears to be more in line with the accuracy of the language-equivalent controls.

The constructions tested/elicited in Redmond (2003) included past participles preceded by *got*, auxiliary HAVE, and auxiliary BE. Crucially, if an auxiliary were omitted completely, an otherwise correct past participle would not be counted as correct. It is unclear how a past participle would be counted in the event an incorrect auxiliary or an auxiliary with omitted finiteness marking were used. Note that because the sole focus was evaluating accuracy on the regular past tense and regular past participle, it could be difficult to differentiate past tense from past participle obligatory contexts without the restriction to overt auxiliaries for past participles.

It is difficult to compare the results of Leonard et al. (2003) and Redmond (2003) for reasons related to the limitations just discussed. Both studies included a small number of participants and the criteria for entry into their respective SLI groups were different. For example, Redmond (2003) included two SLI children with an omnibus language standard score

greater than 85 while SLI children in Leonard et al. (2003) all scored more than 1.5 *SD* below the mean for their age on the language tasks. The language tasks used across studies were different. The difference in mean ages for the SLI groups across studies is seven months. The mean age for Leonard et al. (2003) was 5;6 (*SD* = 10 months) while the mean age for Redmond (2003) was 6;1 (*SD* = 7 months). Recall that a difference in past participle accuracy was observed across groups in Leonard et al. (2003), but not in Redmond (2003). Given the wide range of ages evaluated, especially in Leonard et al. (2003), it is important to ask if there are important differences between younger and older children within the age range as it relates to accuracy on the regular homophonous forms.

The Current Study

The current study aimed to address the inconsistency in the literature by comparing regular past tense and regular past participle accuracy over two times of assessment, and to compare irregular past tense accuracy to accuracy on the irregular past participle. Accuracy levels were assessed using spontaneous language samples collected across two times of assessment, approximately one year apart.

Like the previous studies, this study used a three-group design to allow for comparisons between an SLI group and two control groups. The control groups were comprised of typically developing children that were equivalent in age (with normal language functioning) or equivalent in language (and chronologically younger). Comparing an SLI group's performance to an age-equivalent group's performance determines whether children with SLI are below age expectations on a particular dimension of language. Comparing an SLI group's performance to a language-equivalent group's performance determines whether children with SLI are below general language expectations on a particular dimension of language. As it relates to the current

study, results from Leonard et al. (2003) suggest that children with SLI perform below language expectations on the regular past participle while results from Redmond (2003) suggest that children with SLI perform at age and language expectations on the regular past participle.

In this study, data for past tense and past participle verb forms were available from spontaneous language samples at two different times of assessment. Each attempt at either form was coded for accuracy. Analyses will address the following research questions:

1. Overall accuracy:
    a. Do groups differ in accuracy levels on the regular and irregular past tense across two times of assessment?
    b. Do groups differ in accuracy levels on the regular and irregular past participle across two times of assessment?
    c. If/when children make errors relating to past tense and past participle use, are errors of omission the primary error?
2. Relative accuracy:
    a. Does the SLI group differ in accuracy levels on the regular past tense and the regular past participle across two times of assessment?
    b. Does the SLI group differ in accuracy levels on the irregular past tense and the irregular past participle across two times of assessment?
3. Evaluation of theoretical accounts:
    a. Is the EOI account robust to examinations of homophonous forms with different underlying syntactic representations in English?

i. Is this about the finiteness requirement in the TNS/AGR slot in a clause, or does the same phenomenon hold for other elements in the clause without TNS/AGR that use the same lexical verbs?

The EOI account predicts that children with SLI will show weaknesses in finiteness marking, but not in nonfinite marking – the weakness is at the site-specific levels of abstract syntax, not the morphophonological form. Some grammatical forms are vulnerable, while others are not – as evidenced by auxiliary DO. As a result, the EOI account predicts that children with SLI will be more accurate on the regular past participle than on the regular past tense as morphophonology (i.e., surface form) is not predicted to affect accuracy. Similarly, children with SLI are predicted to be more accurate on the irregular past participle than on the irregular past tense. Note that the regular/irregular distinction is in the domain of morphophonology, not morphosyntax. The EOI account predicts errors of omission to be the primary error in finiteness-required sites. Importantly, under the EOI account, overregularizations of irregular forms are treated as errors of morphophonology and can be counted as attempts at finiteness marking. Contrastingly, the surface account predicts that children with SLI will perform similarly on the regular past tense and the regular past participle as it is the morphophonological properties of the affix that dictate whether or not it will pose a problem for children with SLI. Predictions for the irregular past participle are less clear due to complexities in irregular morphophonology and because, until this study, no one has investigated irregular past participle development in English-speaking children with SLI in conjunction with irregular past tense development.

Methods

Participants

The participants in this study come from a larger family study investigating the development of morphosyntax in children with specific language impairment (SLI) and unaffected children. Siblings of children with SLI (probands) and controls were included and siblings were determined to be either affected or unaffected based on assessments of inclusionary and exclusionary criteria. All participants, irrespective of affectedness status, were recruited through schools in Kansas and Missouri.

For the present study, three groups of children were selected from the Language Acquisition Studies Lab (LASLAB) database of available probands, siblings, and controls. The three groups included: an SLI group, an age-equivalent group (AE), and a language-equivalent group (LE). A description of the inclusionary criteria used to determine affectedness status follows.

The SLI group included children who entered the larger study as probands who met the following criteria of affectedness: 1) monolingual native speaker of English, 2) identified as language impaired by a speech-language pathologist, 3) MLU calculated from a spontaneous language sample below age expectations as demonstrated by a standard score below 85, based on the norms of Rice, Smolik, Perpich, Thompson, Rytting, and Blossom (2010), 4) normal nonverbal abilities as demonstrated by a standard score above 85 on the Columbia Mental Maturity Scale (CMMS) (Burgemeister, Blum, & Lorge, 1972), 5) passing performance on the phonological probe of the *Rice/Wexler Test for Early Grammatical Impairment* (TEGI) (Rice & Wexler, 2001), which evaluates the word-final sounds *–t*, *–d*, *–s*, and *–z*, ensuring that children are able to articulate third person singular present tense and regular past tense morphemes, 6) no

other reported diagnosis of autism, intellectual, behavioral, or social impairments, and 7) passing performance on a hearing screening (ASHA, 1997). Children also completed an omnibus test of language ability and were entered into the study as probands if they scored below 85 standard score on an omnibus measure of language. Children 4;0 and older at the time of entry received the *Test of Language Development – Primary, Second Edition* (TOLD-P2) (Newcomer & Hammill, 1988) and children younger than 4;0 received the *Test of Early Language Development, Second Edition* (TELD-2) (Hresko, Reid, & Hammill, 1991) or the *Test of Early Language Development, Third Edition* (TELD-3) (Hresko, Reid, & Hammill, 1999).

Three children in the SLI group for the present study scored below 85 standard score on the CMMS (83, 84, 84). Given the standard error of measurement of the CMMS for children in the age range of the SLI group (5 standard score points), all three children's scores were within the range of the inclusionary criterion for the CMMS. One child in the SLI group scored above 85 on the TOLD-P2 (86). Given the standard error of measurement of the TOLD-P2 for children in the age range of the SLI group (3 standard score points), the child's score was within the range of the inclusionary criterion for the omnibus test of language ability.

Children who entered the study as unaffected controls met the following criteria: 1) monolingual native speaker of English, 2) identified as typically developing by their guardians and teachers, 3) MLU calculated from a spontaneous language sample within normal range as demonstrated by a standard score above 85, based on the norms of Rice et al. (2010), 4) normal nonverbal abilities as demonstrated by a standard score above 85 on the CMMS, 5) passing performance on the TEGI phonological probe, 6) no other reported diagnosis of autism, intellectual, behavioral, or social impairments, and 7) passing performance on a hearing screening. Unaffected children also received an omnibus test of language ability, the TOLD-P2,

the TELD-2, or the TELD-3 depending on their age at testing and scored above 85 standard score.

One child in the LE group scored below 85 standard score on the CMMS (84). Given the standard error of measurement for the CMMS for children in the age range of the LE group (5 standard score points), the child's score was within the range of the inclusionary criterion for the CMMS.

Siblings included in the affected group in the present study met the following criteria: 1) monolingual native speaker of English, 2) scored below 85 standard score on at least one omnibus test of language ability, 3) normal nonverbal abilities as demonstrated by a standard score above 85 on the CMMS, 4) passing performance on the TEGI phonological probe, 5) no other reported diagnosis of autism, intellectual, behavioral, or social impairments, and 6) passing performance on a hearing screening.

To summarize, three groups of children were included in the present study: an SLI group, an age-equivalent group (AE), and a language-equivalent group (LE). The SLI group included children who entered the larger study as probands and also included siblings who met the criteria of affectedness described above. The AE group and the LE group included children who entered the larger study as unaffected controls as well as any siblings who met the inclusionary criteria and never scored below 85 standard score on an omnibus test of language ability. In the current study, there were 3 siblings in the SLI group, 10 siblings in the AE group, and 4 siblings in the LE group.

Because data for the present study come from spontaneous language samples, children's articulation and phonological difficulties were assessed using the *Goldman-Fristoe Test of Articulation, First Edition* (GFTA) (Goldman & Fristoe, 1986) or the *Goldman-Fristoe Test of*

Articulation, Second Edition (GFTA-2) (Goldman & Fristoe, 2000). Children, in general, scored above the 15th percentile. Although some children scored below the 15th percentile, there was no difficulty in accurately evaluating their knowledge of morphosyntax based on examiner report and data on percent of unintelligible utterances.

In order to compare accuracy on the past tense to accuracy on the past participle, a group of SLI children who were attempting both forms in their spontaneous language samples was identified. After determining which SLI children were eligible to participate based on the inclusionary criteria and their attempts at past tense and past participle forms, the age range was restricted to 4;4 to 6;5 to allow for meaningful developmental comparisons within the present study and for comparisons to be made to both Leonard et al. (2003) and Redmond (2003). The use of the relatively narrow age range was also done purposely to enhance the reliability and validity of the results across two times of assessment.

Using information from the first time of assessment, the SLI group was matched to an AE group of controls, who fell within the same age range, met the inclusionary criteria, and were also attempting both forms in their spontaneous language samples. Finally, the SLI group was matched to a younger LE group of controls who met the inclusionary criteria and were also attempting both forms. Note that there was no overlap in age between the SLI group and the LE group at the first time of assessment. Initial descriptive data revealed variation in the frequency of past tense and past participle use across children. In order to enter initial group calculations, spontaneous samples at the first time of assessment must have included at least two attempts at either a regular or irregular past tense, or regular or irregular past participle form.

Language equivalence was determined using mean language of utterance in morphemes (MLU) calculated from spontaneous language samples. The SLI group had an MLU of 3.65 at

the first time of assessment. Using the inclusionary criteria, there were 65 children with SLI between 4;4 and 6;5 who were attempting past tense and past participle forms at the first time of assessment. The AE group included 59 unaffected children between 4;4 and 6;5 at the first time of assessment. The LE group included 32 unaffected children and all had MLUs that were within 0.1 of at least one child in the SLI group. All control children were attempting past tense and past participle forms at the first time of assessment. Note that the number of children in the LE group was much smaller than that of the SLI group and the AE group. This was due to the nature of the inclusionary criteria as well as the fact that not many children enter the larger study prior to five years of age.

Note that although spontaneous language samples were used to compare accuracy on the regular past tense and the regular past participle, and the irregular past tense and the irregular past participle, these spontaneous language samples were not collected solely for examining children's usage of these forms. Rather, spontaneous language samples were ascertained to assess children's usage of a number of targeted grammatical forms relevant to language development in affected children. Such forms include the third person singular present tense, regular and irregular plurals, auxiliaries, and copulas. Spontaneous language samples were collected by examiners trained to elicit these targeted grammatical forms and lasted approximately 25 minutes. Examiners aimed to collect 200 complete and intelligible utterances, although for the present study, children were required to have at least 50 complete and intelligible utterances for their language samples to be analyzed. In general, a language sample was transcribed and coded by the examiner who collected the sample. Inter-transcriber reliability was over 85% across the utterance, word, morpheme, and code levels.

To summarize, group membership was determined by affectedness. Affected children

ranged in age from 4;4 to 6;5 (*M* = 5;5, *SD* = 0;7) with MLUs between 2.39 and 4.32 (*M* = 3.65, *SD* = 0.45). Unaffected children in this study were included as age-equivalent (AE) or language-equivalent (LE) controls. The AE group ranged in age from 4;4 to 6;5 (*M* = 5;6, *SD* = 0;7) at the first time of assessment. Children included in the LE group had MLUs that were within 0.1 of at least one child in the SLI group at the first time of assessment (*M* = 3.79, *SD* = 0.41). Group descriptive information including the number of children in each group and the means for measures used to enter children into the present study are included in Table 2. Note that the scores for the omnibus language tests were collected within six months of the first language sample analyzed.

Table 2: *Mean, SD, and Range of Participant Characteristics and Inclusionary Criteria*

		SLI	AE	LE
	N	65	59	32
Age	Mean	5;5	5;6	3;3
	SD	(0;7)	(0;7)	(0;6)
	Range	4;4 - 6;5	4;4 - 6;5	2;6 - 4;2
[a]CMMS	Mean	95.11	103.83	105.97
	SD	7.62	9.18	10.79
	Range	83 - 116	85 - 124	84 - 124
[b]Omnibus Language	Mean	76.51	106.05	102.19
	SD	4.79	8.68	8.26
	Range	64 - 86	89 - 122	88 - 119
[c]Complete and Intelligible Utterances	Mean	225.92	212.14	217.13
	SD	65.45	57.75	52.14
	Range	51 - 377	67 - 353	127 - 336
[d]MLU	Mean	3.65	5.22	3.79
	SD	0.45	0.56	0.41
	Range	2.39 - 4.32	4.01 - 6.18	2.79 - 4.34
[e]MLU standard score	Mean	74.68	106.31	100.93
	SD	7.54	10.09	9.34
	Range	46.40 - 85.00	85.00 - 124.00	85.87 - 119.86
[f]GFTA percentile	Mean	37.12	72.02	72.47
	SD	24.66	20.68	22.81
	Range	Jan-94	21 - 99	21 - 99

[a]Columbia Mental Maturity Scale, Standard Score

[b]Omnibus Language: Test of Language Development, Primary Spoken Language Quotient Standard Score (for children 4;0 and older); Test of Early Language Development Spoken Language Quotient Standard Score (for children younger than 4;0)

[c]Complete and Intelligible Utterances, first time of assessment

[d]Mean Length of Utterance in morphemes, first time of assessment

[e]Mean Length of Utterance in morphemes, Standard Score, first time of assessment

[f]Goldman-Fristoe Test of Articulation, Percentile

Spontaneous Language Samples

In previous studies, data on past participles almost exclusively came from elicitation probes. In the present study, data for past tense and past participle forms come from spontaneous language samples. By relying on spontaneous language samples, children were able to use a range of clause structures and verbs. It was possible to capture how past participles were used in conversations and evaluate children's use of past participles in a wide range of contexts. By doing so, children's proficiency with past tense and past participle forms within conversationally appropriate contexts was evaluated. Multiple instances of individual past tense and past participle forms could be documented.

Coding and Counting Procedures

Transcripts included in the current study were largely transcribed and coded by examiners/transcribers who collected the spontaneous language samples. Some samples included in the study preceded implementation of formal past participle coding training for all examiners/transcribers. For those samples, an additional coder coded them for past participle use. Once all files were transcribed and coded, a concordance was generated, which searched for all utterances containing attempts at both past tense and past participle forms of verbs. Past tense and past participle verb attempts were counted by a single counter who also coded the archived samples for past participle use. A second person was trained to evaluate the reliability of the counting. This person was also trained and had high levels of reliability on coding. Inter-coder agreement was over 95% on a subset of transcripts for counting (4.5%).

Accuracy

Utterances generated by the concordances were evaluated for past tense and past participle accuracy. Attempts at the past tense were coded as correct, omission, or overt error.

Attempts were counted as omissions if children produced the root infinitive. Attempts were counted as overt errors if children produced an overregularized form of the verb (irregular past tense only) or produced an incorrect form of the verb (or the wrong verb completely). Consider the following:

Regular past tense:

(12) Henry *walked* home. (regular past tense, correct)

(13) *Henry *walk* home. (regular past tense, omission)

(14) *Henry *walkeded* home. (regular past tense, overt error)

Irregular past tense:

(15) Henry *broke* the vase. (irregular past tense, correct)

(16) *Henry *break* the vase. (irregular past tense, omission)

(17) *Henry *breaked* the vase. (irregular past tense, overt error)

(18) *Henry *brokes* the vase. (irregular past tense, overt error)

Utterances generated by the concordances were also evaluated for past participle accuracy. Attempts were coded as correct, omission, or overt error. Attempts were counted as omissions if children produced the root infinitive. Attempts were counted as overt errors if children produced an overregularized form of the verb (irregular past participle only) or produced an incorrect form of the verb (or the wrong verb completely). Attempts were counted as correct, omission, or overt error irrespective of the accuracy of the preceding auxiliary verb. Note that because data come from spontaneous samples, there were instances where auxiliaries were not required to precede a past participle given the conversational context. Consider the following exchange between an examiner and a child:

Examiner: What are these two?

Examiner: They're not?

Child: No, not *scared*.

Examiner: Oh, good.

Note that because the examiner provided the child with both "they" and "are," the child was able to produce a well-formed utterance with a past participle without producing the otherwise obligatory subject and auxiliary.

Regular past participle:

(19) Henry (had) *walked* home. (regular past participle, correct)

(20) *Henry (had) *walk* home. (regular past participle, omission)

(21) *Henry (had) *walkeded* home. (regular past participle, overt error)

Irregular past participle:

(22) Henry (had) *broken* the vase. (irregular past participle, correct)

(23) *Henry (had) *break* the vase. (irregular past participle, omission)

(24) *Henry (had) *breaked* the vase. (irregular past participle, overt error)

(25) *Henry (had) *breaks* the vase. (irregular past participle, overt error)

Because the accuracy of past participle attempts was evaluated in obligatory contexts which may have had an omitted auxiliary, the counting scheme was biased to count only overtly inflected irregular past participles with omitted auxiliaries. As a result, the examples (19) through (25) should not be taken to imply equal likelihood of omitted *had* in both forms. The conservative nature of the coding procedure enhances the validity and reliability of the results. However, there were cases where a regular past participle could be coded in the absence of a preceding auxiliary (e.g., *supposed* to go home), as demonstrated by the exchange between the examiner and child.

Errors

As just stated, incorrect attempts at past tense and past participle forms were coded as errors. Errors were coded as omissions or overt errors. Attempts were counted as overt errors if children produced an overregularized form (irregular forms only), produced an incorrect form, or produced the wrong verb completely. Recall that overregularization errors are errors of morphophonology and, unlike other overt errors, can be counted as attempts at finiteness marking or correct irregular past participle inflection. As a result, the proportion of past tense and past participle attempts coded as overt errors (collapsed across all types of overt errors) and the proportion of past tense and past participle attempts coded as overregularizations were qualitatively compared across groups.

Verb Exceptions

Note that although the present study evaluated irregular past tense and irregular past participle accuracy, irregular verbs that have the same surface form for both the present and past tense were not included. Such verbs include *hit*, *hurt*, and *put*. Such verbs also have the same surface form for the past participle. Refer, again, to Table 1 for a summary of irregular past tense and irregular past participle verb forms. Recall that for the purposes of the present study, accuracy on irregular verbs is evaluated collapsing across all classes, with the exception of the no-change/zero-change verbs just described.

Alternating Forms

Finally, there was a small set of verbs used by the children that had two acceptable surface forms for either the past tense or past participle. Such pairs included *got*/*gotten* and *burned*/*burnt* and such alternating forms were determined to be permissible following Quirk et

al. (1985). When used correctly within the conversational context, children were given credit for producing either form.

Results

The purpose of this study was to examine regular past tense and regular past participle accuracy over two times of assessment, and to explicitly compare irregular past tense accuracy to accuracy on the irregular past participle. Research questions were developed to examine performance levels on these language forms for children with SLI and typically developing age- and language-equivalent controls. Results are reported for each question.

Data were analyzed using a 3 group (i.e., SLI v. AE v. LE) x 2 dimension (i.e., past tense v. past participle) x 2 morphology (i.e., regular v. irregular) multilevel model containing a random intercept parameter to address dependencies due to repeated measurements within subject using Stata's *xtmixed* command (StataCorp, 2011). Multilevel modeling was used to allow for the inclusion of all available data without forcing list-wise deletion, as required by repeated measures analysis of variance. Model details are available in the appendices including the marginal means and standard errors. Minimal criterion for inclusion in the model was at least two attempts at any one of the four forms at the first time of assessment. Participants could make any number of attempts, including 0, at the second time of assessment. As a result, each participant had 2, 4, 6, or 8 repeated observations depending on whether they met the scoring criterion for multiple forms.

Table 3 and Table 4 provide the sample means, standard deviations, and ranges of proportion correct for the past tense and past participle forms. These tables also include the number of participants eligible for comparisons on any form based on the two-attempt criterion at Time 1. Any difference in the number of participants from Time 1 to Time 2 reflects the number of participants who made 0 attempts at a particular form at Time 2 after having made at least two attempts at Time 1. Sample means reported in the tables provided are all within 0.01

(i.e., 1.0%) of the model estimated population means; however, any comparisons of groups across time or form are based on the model estimated population means and the associated standard errors. Table 3 and Table 4 also include 95% confidence intervals (CI) for each sample mean. Each model comparison includes the contrast (*diff.*), the test statistic (z), the p-value for the test statistic (p), and the effect size (Cohen's d; d).

Performance was first compared on the past tense, which could be benchmarked to previous studies.

1a. Do groups differ in accuracy levels on the regular and irregular past tense across two times of assessment?

Regular Past Tense

At the first time of assessment, the SLI group made a mean of 6.29 (SD = 6.30) attempts at the regular past tense, the AE group made a mean of 6.19 (SD = 4.58) attempts, and the LE group made a mean of 4.54 (SD = 2.01) attempts. At the second time of assessment, the SLI group made a mean of 6.51 (SD = 4.89) attempts, the AE group made a mean of 9.37 (SD = 10.11) attempts, and the LE group made a mean of 4.23 (SD = 3.99) attempts.

For the first time of assessment, the model estimated means for accuracy evidenced some significant group differences between the AE group and both the SLI group (*diff.* = 0.38, z = 8.97, $p < 0.001$, d = 1.75) and the LE group (*diff.* = 0.38, z = 7.27, $p < 0.001$, d = 1.77). However, the SLI group and the LE group did not significantly differ (*diff.* = 0.00, z = 0.04, p = 0.968, d = 0.01). As reported in Table 3, the sample mean proportion correct on the regular past tense was highest for the AE group with 93.4% correct while the SLI group and LE group were at 55.8% and 55.3%. For the second time of assessment, the model showed a significant difference between the AE group and the SLI group (*diff.* = 0.17, z = 3.97, $p < 0.001$, d = 0.79). However,

the SLI group and the LE group did not significantly differ (*diff.* = 0.10, $z = 1.85$, $p = 0.064$, $d = 0.46$), nor did the AE group and the LE group (*diff.* = 0.07, $z = 1.33$, $p = 0.184$, $d = 0.34$). Again, based on the sample means, the AE group was the most accurate on the regular past tense with 97.1% correct while the SLI group and the LE group were at 80.4% and 89.9%. Note that the LE group scored between the SLI group and the AE group and was not significantly different from either.

There was no significant difference in proportion correct between the first and second times of assessment for the AE group (*diff.* = 0.04, $z = 0.90$, $p = 0.371$, $d = 0.18$), which was expected given their level of performance at the first time of assessment. However, there was a significant difference for the LE group (*diff.* = 0.35, $z = 5.86$, $p < 0.001$, $d = 1.69$) and the SLI group (*diff.* = 0.24, $z = 6.09$, $p < 0.001$, $d = 1.18$) between the first and second times of assessment. While the AE group performed similarly at both times of assessment (93.4% and 97.1%, respectively), the LE group's performance increased from 55.3% to 89.9% and the SLI group's performance increased from 55.8% to 80.4%. Such results are consistent with previous literature (cf. Rice et al., 1998).

Irregular Past Tense

At the first time of assessment, the SLI group made a mean of 13.95 (*SD* = 9.08) attempts at the irregular past tense, the AE group made a mean of 17.19 (*SD* = 9.76) attempts, and the LE group made a mean of 13.25 (*SD* = 6.99) attempts. At the second time of assessment, the SLI group made a mean of 18.70 (*SD* = 12.08) attempts, the AE group made a mean of 26.67 (*SD* = 22.47) attempts, and the LE group made a mean of 15.38 (*SD* = 8.68) attempts.

For the first time of assessment, the model estimated means for accuracy evidenced some significant group differences between the AE group and both the SLI group (*diff.* = 0.28, *z* =

7.04, $p < 0.001$, $d = 1.30$) and the LE group (*diff.* = 0.30, $z = 6.19$, $p < 0.001$, $d = 1.38$). However, the SLI group and the LE group did not significantly differ (*diff.* = 0.02, $z = 0.32$, $p = 0.745$, $d = 0.07$). As reported in Table 3, the sample mean proportion correct on the irregular past tense was highest for the AE group with 94.6% correct while the SLI group and the LE group were at 66.3% and 64.8%. For the second time of assessment, the model showed significant group differences between the AE group and both the SLI group (*diff.* = 0.17, $z = 4.24$, $p < 0.001$, $d = 0.78$) and the LE group (*diff.* = 0.15, $z = 3.13$, $p = 0.002$, $d = 0.70$). However, the SLI group and the LE group did not significantly differ (*diff.* = 0.02, $z = 0.40$, $p = 0.689$, $d = 0.09$). As reported in Table 3, the sample mean proportion correct on the irregular past tense was highest for the AE group with 96.2% correct while the SLI group and the LE group were at 79.1% and 81.1%.

There was no significant difference in proportion correct between the first and second times of assessment for the AE group (*diff.* = 0.02, $z = 0.41$, $p = 0.679$, $d = 0.08$), which was expected given their level of performance at the first time of assessment. However, there was a significant difference for the LE group (*diff.* = 0.16, $z = 3.13$, $p = 0.002$, $d = 0.80$) and the SLI group (*diff.* = 0.13, $z = 3.41$, $p = 0.001$, $d = 0.62$) between the first and second times of assessment. While the AE group performed similarly at both times of assessment (94.6% and 96.2%, respectively), the LE group's performance increased from 64.8% to 81.1% and the SLI group's performance increased from 66.3% to 79.1%. Such patterns of performance are consistent with previous literature (cf. Rice et al., 2000).

Following the precedents in the literature, overregularizations can be counted as attempts at finiteness marking. For this purpose, the model was rerun with an adjusted dependent variable such that children were given credit for overregularized attempts. When the morphophonological requirement was relaxed to include overregularizations as attempts at finiteness marking, the

model showed a similar pattern of results. For the first time of assessment, the model estimated means for accuracy evidenced some significant group differences between the AE group and both the SLI group (*diff.* = 0.23, $z = 6.20$, $p < 0.001$, $d = 1.15$) and the LE group (*diff.* = 0.20, $z = 4.44$, $p < 0.001$, $d = 0.99$). However, the SLI group and the LE group did not significantly differ (*diff.* = 0.03, $z = 0.73$, $p = 0.466$, $d = 0.16$). As reported in Table 3, the sample mean proportion correct on the irregular past tense finiteness marking was highest for the AE group with 97.4% correct while the SLI group and LE group were at 74.1 % and 77.5%. For the second time of assessment, the model showed a significant difference between the AE group and the SLI group (*diff.* = 0.10, $z = 2.68$, $p = 0.007$, $d = 0.50$); however, the AE group and the LE group did not significantly differ (*diff.* = 0.04, $z = 1.00$, $p = 0.317$, $d = 0.22$), nor did the SLI group and the LE group (*diff.* = 0.06, $z = 1.24$, $p = 0.213$, $d = 0.27$). As reported in Table 3, the sample mean proportion correct on the irregular past tense finiteness marking was highest for the AE group with 97.9% correct while the SLI group and the LE group were at 87.8% and 93.4%.

Even after relaxing the morphophonological requirement, the pattern of within group differences from Time 1 to Time 2 remained unchanged. There was no significant difference in proportion correct between the first and second times of assessment for the AE group (*diff.* = 0.01, $z = 0.15$, $p = 0.879$, $d = 0.03$), which was expected given their level of performance at the first time of assessment. However, there was a significant difference for the LE group (*diff.* = 0.16, $z = 3.37$, $p = 0.001$, $d = 0.86$) and the SLI group (*diff.* = 0.14, $z = 3.98$, $p < 0.001$, $d = 0.73$) between the first and second times of assessment. While the AE group performed similarly at both times of assessment (97.4% and 97.9%, respectively), the LE group's performance increased from 77.5% to 93.4% and the SLI group's performance increased from 74.1% to 87.8%.

Table 3: *Sample Mean, SD, Range, and 95% CI of the Proportion Correct for Past Tense Use*

	Time		SLI	AE	LE
Regular Past Tense	1	N	55	52	26
		Mean	55.8^{ad}	93.4^{ab}	55.3^{be}
		SD	36.0	12.8	38.6
		CI	46.1 - 65.6	89.8 - 97.0	39.8 - 70.9
		Range	0 - 100	50.0 - 100	0 - 100
	2	N	53	49	24
		Mean	80.4^{cd}	97.1^{c}	89.9^{e}
		SD	22.8	9.0	19.7
		CI	74.1 - 86.7	94.5 - 99.7	81.5 - 98.2
		Range	17.0 - 100	50.0 - 100	25.0 - 100
Irregular Past Tense	1	N	61	58	32
		Mean	66.3^{fj}	94.6^{fg}	64.8^{gk}
		SD	26.4	8.3	23.5
		CI	59.5 - 73.0	92.4 - 96.8	56.3 - 73.3
		Range	0 - 100	67.0 - 100	10.0 - 100
	2	N	61	58	32
		Mean	79.1^{hj}	96.2^{hi}	81.1^{ik}
		SD	18.4	5.8	15.4
		CI	74.4 - 83.8	94.7 - 97.7	75.6 - 86.7
		Range	25.0 - 100	78.0 - 100	47.0 - 100
Irregular Past Tense - Finiteness (Relaxed Morphophonology)	1	N	61	58	32
		Mean	74.1^{lo}	97.4^{lm}	77.5^{mp}
		SD	26.4	5.2	23.9
		CI	67.4 - 80.9	96.0 - 98.7	68.9 - 86.1
		Range	0 - 100	75.0 - 100	10.0 - 100
	2	N	61	58	32
		Mean	87.8^{no}	97.9^{n}	93.4^{p}
		SD	13.8	3.8	8.2
		CI	84.2 - 91.3	96.9 - 98.9	90.5 - 96.4
		Range	27.0 - 100	83.0 - 100	73.0 - 100

Note: Sample means sharing a letter are significantly different at the 0.05 level based on model comparisons.

1b. Do groups differ in accuracy levels on the regular and irregular past participle across two times of assessment?

Regular Past Participle

At the first time of assessment, the SLI group made a mean of 4.14 (*SD* = 2.26) attempts at the regular past participle, the AE group made a mean of 4.23 (*SD* = 2.81) attempts, and the LE group made a mean of 3.90 (*SD* = 1.66) attempts. At the second time of assessment, the SLI group made a mean of 2.94 (*SD* = 2.93) attempts, the AE group made a mean of 5.03 (*SD* = 3.38) attempts, and the LE group made a mean of 1.90 (*SD* = 1.60) attempts.

For the first time of assessment, the model estimated means for accuracy evidenced significant group differences between the AE group and the SLI group (*diff.* = 0.24, $z = 4.80$, $p < 0.001$, $d = 1.12$) as well as the LE group and the SLI group (*diff.* = 0.18, $z = 2.38$, $p = 0.017$, $d = 0.87$). However, the AE group and the LE group did not significantly differ (*diff.* = 0.06, $z = 0.72$, $p = 0.470$, $d = 0.26$). As reported in Table 4, the sample mean proportion correct on the regular past participle was highest for the AE group with 98.8% correct while the SLI group and the LE group were at 75.1% and 93.6%. For the second time of assessment, the model showed no significant difference between the AE group and the SLI group (*diff.* = 0.09, $z = 1.76$, $p = 0.079$, $d = 0.43$) nor the LE group and the SLI group (*diff.* = 0.07, $z = 0.86$, $p = 0.391$, $d = 0.35$). Again, there was no significant difference between the AE group and the LE group (*diff.* = 0.02, $z = 0.23$, $p = 0.818$, $d = 0.09$). As reported in Table 4, the sample mean proportion correct on the regular past participle was highest for the AE group with 98.3% correct while the SLI group and the LE group were at 89.4% and 96.9%.

There was no significant difference in proportion correct between the first and second times of assessment for the AE group (*diff.* = 0.01, $z = 0.12$, $p = 0.906$, $d = 0.03$) nor was there a

significant difference between the two times of assessment for the LE group (*diff.* = 0.03, z = 0.31, p = 0.759, d = 0.16). However, there was a significant difference between the two times of assessment for the SLI group (*diff.* = 0.14, z = 2.76, p = 0.006, d = 0.69). While the AE group and the LE group preformed similarly (98.8% and 98.3%, and 93.6% and 96.9%, respectively), the SLI group's performance increased from 75.1% to 89.4%.

Irregular Past Participle

At the first time of assessment, the SLI group made a mean of 3.47 (*SD* = 2.06) attempts at the irregular past participle, the AE group made a mean of 3.91 (*SD* = 2.11) attempts, and the LE group made a mean of 3.67 (*SD* = 1.53) attempts. At the second time of assessment, the SLI group made a mean of 3.28 (*SD* = 4.07) attempts, the AE group made a mean of 4.26 (*SD* = 3.25) attempts, and the LE group made a mean of 2.78 (*SD* = 3.21) attempts.

For the first time of assessment, the model estimated means for accuracy evidenced no significant difference between the AE group and the SLI group (*diff.* = 0.06, z = 1.00, p = 0.315, d = 0.27) nor the LE group and the SLI group (*diff.* = 0.02, z = 0.35, p = 0.726, d = 0.10). The AE group and the LE group also did not significantly differ (*diff.* = 0.08, z = 1.17, p = 0.240, d = 0.38). As reported in Table 4, the sample mean proportion correct on the irregular past participle was highest for the LE group with 91.7% correct while the SLI group and the AE group were at 89.3% and 84.3%. For the second time of assessment, the model showed no significant difference between the AE group and the SLI group (*diff.* = 0.06, z = 0.91, p = 0.361, d = 0.26) nor the AE group and the LE group (*diff.* = 0.14, z = 1.84, p = 0.065, d = 0.65); however, there was a significant difference between the SLI group and the LE group (*diff.* = 0.19, z = 2.73, p = 0.006, d = 0.91). As reported in Table 4, the sample mean proportion correct on the irregular past

participle was highest for the SLI group with 88.9% correct while the AE group and the LE group were at 83.9% and 69.1%.

There was no significant difference in proportion correct between the first and second times of assessment for the AE group (*diff.* = 0.01, $z = 0.10$, $p = 0.918$, $d = 0.03$) nor was there a significant difference between the two times of assessment for the SLI group (*diff.* = 0.01, $z = 0.17$, $p = 0.868$, $d = 0.04$). However, there was a significant difference between the two times of assessment for the LE group (*diff.* = 0.22, $z = 2.99$, $p = 0.003$, $d = 1.10$). While the AE group and the SLI group preformed similarly (84.3% and 83.9%, and 89.3% and 88.9%, respectively), the LE group's performance decreased from 91.7% to 69.1%. Possible reasons for the LE group's decrease in performance will be discussed.

Just as with the irregular past tense, the model was rerun with an adjusted dependent variable such that children were given credit for overregularized attempts. When the morphophonological requirement was relaxed to include overregularizations as attempts at correct irregular past participle inflection, the model estimated means showed a similar pattern of results. For the first time of assessment, there was no significant difference between the AE group and the SLI group (*diff.* = 0.02, $z = 0.41$, $p = 0.681$, $d = 0.11$) nor the LE group and the SLI group (*diff.* = 0.02, $z = 0.40$, $p = 0.690$, $d = 0.12$). The AE group and the LE group did not significantly differ (*diff.* = 0.05, $z = 0.71$, $p = 0.475$, $d = 0.23$). As reported in Table 4, the sample mean proportion correct on the irregular past participle was highest for the LE group with 94.4% correct while the SLI group and the AE group were at 92.0% and 90.7%. For the second time of assessment, the model showed no significant difference between the AE group and the SLI group (*diff.* = 0.08, $z = 1.48$, $p = 0.140$, $d = 0.43$) nor the AE group and the LE group (*diff.* = 0.03, $z = 0.40$, $p = 0.687$, $d = 0.14$). There was also no significant difference between the SLI group and

the LE group (*diff.* = 0.06, $z = 0.86$, $p = 0.391$, $d = 0.29$). As reported in Table 4, the sample mean proportion correct on the irregular past participle after relaxing the morphophonological requirement was highest for the SLI group with 96.9% correct while the AE group and the LE group were at 89.1% and 90.5%.

After relaxing the morphophonological requirement, the pattern of within group differences from Time 1 to Time 2 changed. As before, there were no significant differences in proportion correct between the first and second times of assessment for the AE group (*diff.* = 0.02, $z = 0.31$, $p = 0.753$, $d = 0.09$) or the SLI group (*diff.* = 0.04, $z = 0.92$, $p = 0.356$, $d = 0.23$); however, by relaxing the morphophonological requirement, there was also no significant difference in proportion correct between the two times of assessment for the LE group (*diff.* = 0.04, $z = 0.52$, $p = 0.603$, $d = 0.19$). All groups preformed similarly at both times of assessment: SLI, 92.0% and 96.9%; AE, 90.7% and 89.1%; and LE, 94.4% and 90.5%.

Table 4: *Sample Mean, SD, Range, and 95% CI of the Proportion Correct for Past Participle Use*

	Time		SLI	AE	LE
Regular Past Participle	1	N	36	40	10
		Mean	75.1[abc]	98.8[a]	93.6[b]
		SD	35.1	7.9	16.0
		CI	63.2 - 86.9	96.2 - 100	82.2 - 100
		Range	0 - 100	50.0 - 100	50.0 - 100
	2	N	31	37	8
		Mean	89.4[c]	98.3	96.9
		SD	24.8	5.1	8.8
		CI	80.3 - 98.4	96.6 - 100	89.5 - 100
		Range	0 - 100	83.0 - 100	75.0 - 100
Irregular Past Participle	1	N	36	23	18
		Mean	89.3	84.3	91.7[e]
		SD	22.5	20.7	25.7
		CI	81.6 - 96.9	75.3 - 93.3	78.9 - 100
		Range	0 - 100	33.0 - 100	0 - 100
	2	N	29	22	14
		Mean	88.9[d]	83.9	69.1[de]
		SD	23.7	30.8	41.8
		CI	79.8 - 97.9	70.2 - 97.5	44.9 - 93.2
		Range	0 - 100	0 - 100	0 - 100
Irregular Past Participle - Relaxed Morphophonology	1	N	36	23	18
		Mean	92.0	90.7	94.4
		SD	20.5	17.2	23.6
		CI	85.1 - 99.0	83.2 - 98.1	82.7 - 100
		Range	0 - 100	50.0 - 100	0 - 100
	2	N	29	22	14
		Mean	96.9	89.1	90.5
		SD	10.3	24.8	27.5
		CI	93.0 - 100	78.1 - 100	74.6 - 100
		Range	50.0 - 100	0 - 100	0 - 100

Note: Sample means sharing a letter are significantly different at the 0.05 level based on model comparisons.

1c. If/when children make errors relating to past tense and past participle use, are errors of omission the primary error?

To calculate the proportion of attempts containing omissions, the total number of omissions for each participant was divided by their total number of attempts. Similarly, to calculate the proportion of attempts containing overt errors, the total number of overt errors for each participant was divided by their total number of attempts.

For both the regular past tense and the regular past participle, all groups made proportionally more errors of omission than any other kind of error (see Table 5 and Table 6). Note that unlike the proportion correct, which was modeled, omissions and overt errors were not modeled. Comparisons are based on a qualitative assessment of sample mean proportions. For example, at Time 1, 44.2% of the SLI group's attempts at the regular past tense contained errors of omission while 0% contained overt errors. At Time 2, 19.6% of the SLI group's attempts at the regular past tense contained errors of omission while, again, 0% contained overt errors. This same pattern of performance was observed for both the AE group and the LE group.

For the irregular past tense and the irregular past participle, a different pattern emerged (see Table 5 and Table 6). For the SLI group, errors of omission were the primary error at Time 1 and Time 2 for the irregular past tense as well as the irregular past participle at Time 1. However, for the irregular past participle at Time 2, the SLI group actually made proportionally fewer errors of omission. Instead, the SLI group made more overregularization errors on the irregular past participle (see Table 7). To calculate the proportion of attempts containing overregularizations, the total number of overregularizations for each participant was divided by their total number of attempts. For the LE group, errors of omission were the primary error at Time 1 for both the irregular past tense and the irregular past participle. However, at Time 2, the

LE group made proportionally fewer errors of omission, due in part to the increase in overregularized irregular past tense and irregular past participle verbs (see Table 7). Similarly, the AE group made proportionally fewer errors of omission on the irregular past tense and the irregular past participle at both Time 1 and Time 2.

Table 5: *Sample Mean (SD) Proportion of Past Tense Omissions and Overt Errors*

		SLI	AE	LE
Regular Past Tense	Time 1			
	N	55	52	26
Omissions	Mean (SD)	44.2 (36.0)	5.5 (12.4)	44.7 (38.6)
Overt Errors	Mean (SD)	0 (0)	1.1 (4.1)	0 (0)
	Time 2			
	N	53	49	24
Omissions	Mean (SD)	19.6 (22.8)	1.7 (5.7)	10.1 (19.7)
Overt Errors	Mean (SD)	0 (0)	1.2 (7.2)	0 (0)
Irregular Past Tense	Time 1			
	N	61	58	32
Omissions	Mean (SD)	24.2 (24.7)	1.8 (3.9)	22.3 (24.1)
Overt Errors	Mean (SD)	9.6 (12.4)	3.6 (6.5)	13.0 (16.6)
	Time 2			
	N	61	58	32
Omissions	Mean (SD)	11.5 (14.0)	1.7 (3.2)	5.8 (7.8)
Overt Errors	Mean (SD)	9.4 (11.5)	2.2 (4.0)	13.1 (13.0)

Table 6: *Sample Mean (SD) Proportion of Past Participle Omissions and Overt Errors*

		SLI	AE	LE
Regular Past Participle	Time 1			
	N	36	40	10
Omissions	Mean (SD)	23.3 (33.7)	1.3 (7.9)	6.4 (16.0)
Overt Errors	Mean (SD)	1.6 (6.8)	0 (0)	0 (0)
	Time 2			
	N	31	37	8
Omissions	Mean (SD)	10.6 (24.8)	1.4 (4.6)	3.1 (8.8)
Overt Errors	Mean (SD)	0 (0)	0.4 (2.3)	0 (0)
Irregular Past Participle	Time 1			
	N	36	23	18
Omissions	Mean (SD)	6.8 (20.3)	0 (0)	5.6 (23.6)
Overt Errors	Mean (SD)	3.9 (12.4)	15.7 (20.7)	2.8 (11.8)
	Time 2			
	N	29	22	14
Omissions	Mean (SD)	1.2 (4.9)	0 (0)	0 (0)
Overt Errors	Mean (SD)	9.9 (22.8)	16.2 (30.8)	31.0 (41.8)

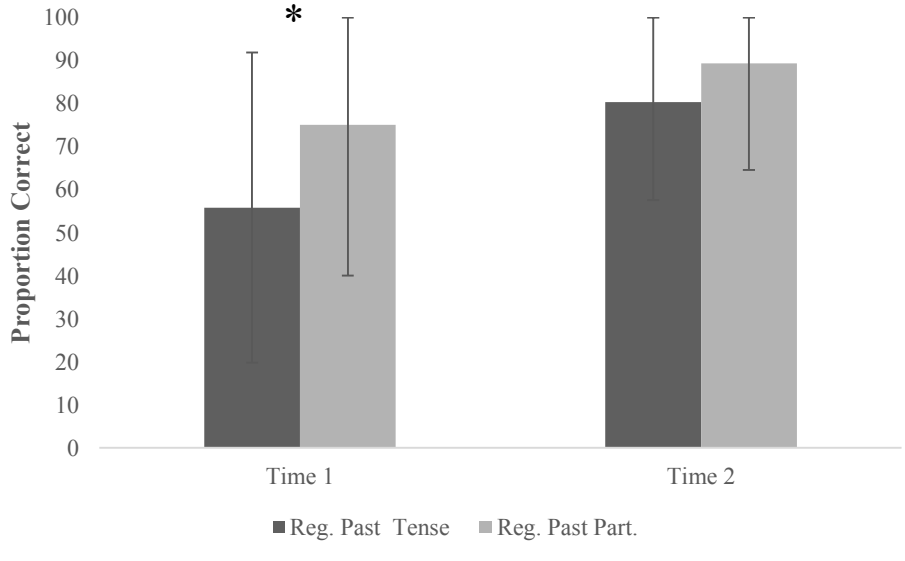
Table 7: *Sample Mean (SD) Proportion of Past Tense and Past Participle Overregularizations*

		SLI	AE	LE
Irregular Past Tense	Time 1			
	N	61	58	32
Overregularizations	Mean (SD)	7.9 (11.6)	2.8 (5.7)	12.7 (16.4)
	Time 2			
	N	61	58	32
Overregularizations	Mean (SD)	8.6 (11.4)	1.7 (3.2)	12.3 (12.8)
Irregular Past Participle	Time 1			
	N	36	23	18
Overregularizations	Mean (SD)	2.8 (11.6)	6.4 (12.5)	2.8 (11.8)
	Time 2			
	N	29	22	14
Overregularizations	Mean (SD)	8.1 (21.5)	5.2 (21.4)	21.4 (37.8)

2a. Does the SLI group differ in accuracy levels on the regular past tense and the regular past participle across two times of assessment?

At the first time of assessment, the SLI group was significantly more accurate on the regular past participle than on the regular past tense (*diff.* = 0.19, $z = 4.31$, $p < 0.001$, $d = 0.93$), based on the model comparison. Recall that the SLI group was at 55.8% on the regular past tense and 75.1% on the regular past participle (based on sample means). At the second time of assessment, the SLI group's accuracy on the regular past tense and the regular past participle was not significantly different (*diff.* = 0.09, $z = 1.92$, $p = 0.055$, $d = 0.44$), based on the model comparison. Recall that the SLI group was at 80.4% on the regular past tense and 89.4% on the regular past participle (based on sample means). See Figure 3 for comparisons of the regular past tense and the regular past participle at Time 1 and Time 2 for the SLI group. Note that the error bars represent the standard deviations for the sample means; an asterisk is used to denote significant differences based on model comparisons.

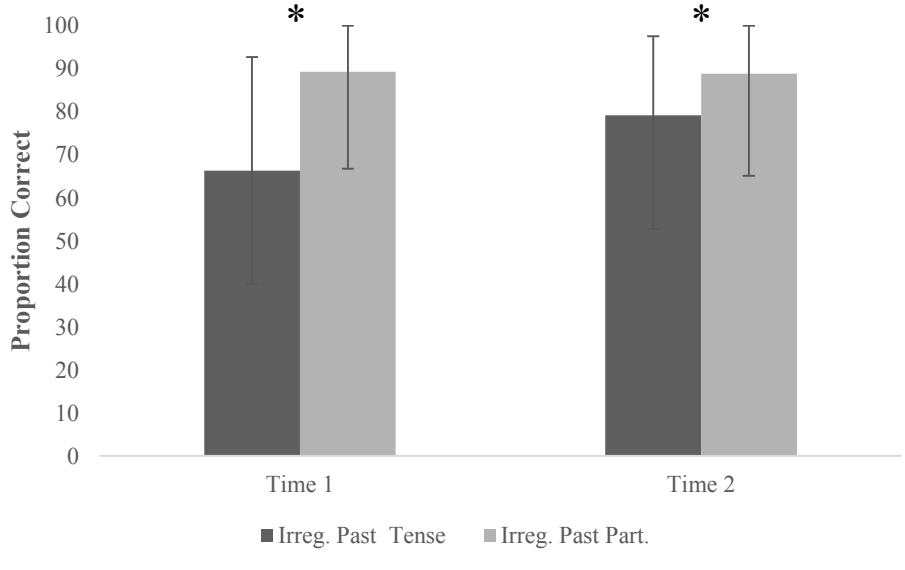
Figure 3: *SLI: Regular Past Tense v. Regular Past Participle*



2b. Does the SLI group differ in accuracy levels on the irregular past tense and the irregular past participle across two times of assessment?

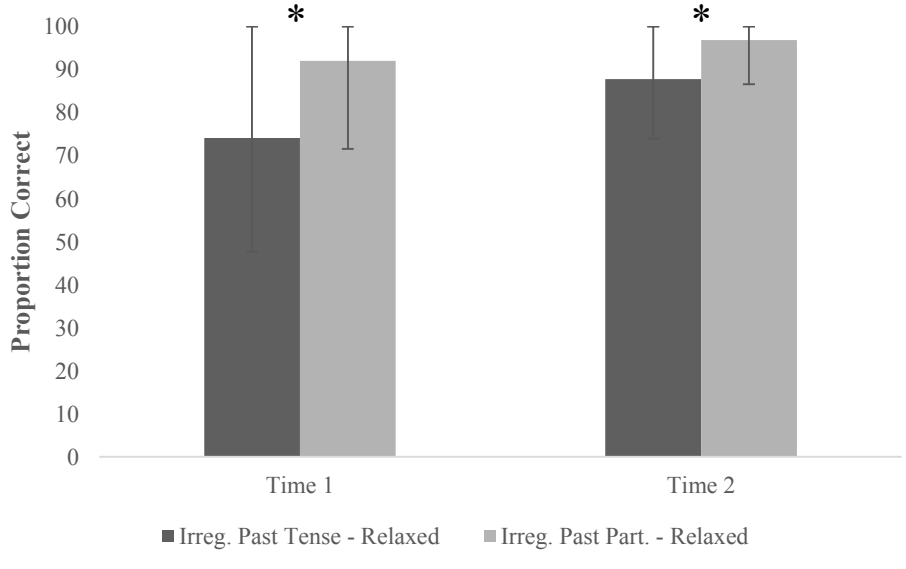
At the first time of assessment, the SLI group was significantly more accurate on the irregular past participle than on the irregular past tense (*diff.* = 0.24, $z = 5.36$, $p < 0.001$, $d = 1.14$), based on the model comparison. The SLI group was at 66.3% on the irregular past tense and at 89.3% on the irregular past participle (based on sample means). At the second time of assessment, the SLI group was again significantly more accurate on the irregular past participle than on the irregular past tense (*diff.* = 0.10, $z = 2.09$, $p = 0.037$, $d = 0.48$), based on the model comparison. The SLI group was at 79.1% on the irregular past tense and 88.9% on the irregular past participle (based on sample means). See Figure 4 for comparisons of the irregular past tense and the irregular past participle at Time 1 and Time 2 for the SLI group. Note that the error bars represent the standard deviations for the sample means; an asterisk is used to denote significant differences based on model comparisons.

Figure 4: *SLI: Irregular Past Tense v. Irregular Past Participle – Morphophonological Form*



Even after relaxing the morphophonological requirement to allow for overregularizations to count toward finiteness marking on the irregular past tense and correct attempts at irregular past participle inflection, the pattern of results remained unchanged. At the first time of assessment, the SLI group was significantly more accurate on the irregular past participle than on the irregular past tense (*diff.* = 0.18, $z = 4.56$, $p < 0.001$, $d = 0.97$), based on the model comparison. The SLI group was at 74.1% on the irregular past tense and at 92.0% on the irregular past participle (based on sample means). At the second time of assessment, the SLI group was again significantly more accurate on the irregular past participle than on the irregular past tense (*diff.* = 0.09, $z = 2.10$, $p = 0.036$, $d = 0.48$), based on the model comparison. The SLI group was at 87.8% on the irregular past tense and 96.9% on the irregular past participle (based on sample means). See Figure 5 for comparisons of the irregular past tense and the irregular past participle with the relaxed morphophonological requirement at Time 1 and Time 2 for the SLI group. Note that the error bars represent the standard deviations for the sample means; an asterisk is used to denote significant differences based on model comparisons.

Figure 5: *SLI: Irregular Past Tense v. Irregular Past Participle – Relaxed Morphophonology*



3a. Is the EOI account robust to examinations of homophonous forms with different underlying syntactic representations in English?

To review, the EOI account predicts that children with SLI will show weaknesses in finiteness marking, but not in nonfinite marking of past participles. Thus, the EOI account predicts that children with SLI will be more accurate on the regular past participle than on the regular past tense. Similarly, children with SLI are predicted to be more accurate on the irregular past participle than on the irregular past tense. As predicted by the EOI account, the past tense was more difficult than the past participle for children with SLI irrespective of form, which replicates previous findings. For SLI children, the past participle is easier than the past tense, with the irregular past participle conferring an even greater advantage than the regular past participle. Thus, homophonous forms have different accuracy levels for children with SLI, presumably attributable to the finiteness function of morphosyntax.

The implications of these findings as they relate to the EOI account and the surface account are discussed further in the following section. Results for all groups across both times of assessment are summarized in Table 8 and Table 9.

Table 8: *Summary of Model Statistical Comparisons (Morphophonological Requirement)*

	Time 1	Time 2
Regular Past Tense	AE > SLI	AE > SLI
	AE > LE	AE = LE
	SLI = LE	SLI = LE
	AE	Time 1 = Time 2
	SLI	Time 2 > Time 1
	LE	Time 2 > Time 1
Irregular Past Tense	AE > SLI	AE > SLI
	AE > LE	AE > LE
	SLI = LE	SLI = LE
	AE	Time 1 = Time 2
	SLI	Time 2 > Time 1
	LE	Time 2 > Time 1
Regular Past Participle	AE > SLI	AE = SLI
	AE = LE	AE = LE
	LE > SLI	LE = SLI
	AE	Time 1 = Time 2
	SLI	Time 2 > Time 1
	LE	Time 1 = Time 2
Irregular Past Participle	AE = SLI	AE = SLI
	AE = LE	AE = LE
	SLI = LE	SLI > LE
	AE	Time 1 = Time 2
	SLI	Time 1 = Time 2
	LE	Time 1 > Time 2

Table 9: *Summary of Model Statistical Comparisons (Relaxed Morphophonological Requirement)*

	Time 1	Time 2
Irregular Past Tense - Finiteness (Relaxed Morphophonology)	AE > SLI	AE > SLI
	AE > LE	AE = LE
	SLI = LE	SLI = LE
	AE	Time 1 = Time 2
	SLI	Time 2 > Time 1
	LE	Time 2 > Time 1
Irregular Past Participle - Relaxed Morphophonology	AE = SLI	AE = SLI
	AE = LE	AE = LE
	SLI = LE	SLI = LE
	AE	Time 1 = Time 2
	SLI	Time 1 = Time 2
	LE	Time 1 = Time 2

Discussion

This study aimed to address an inconsistency in the literature by comparing regular past tense and regular past participle accuracy across two times of assessment, and to compare irregular past tense accuracy to accuracy on the irregular past participle. A three-group design was used, which allowed for comparisons to be made within groups across two times of assessment and across groups at each time of assessment. Accuracy levels were assessed using spontaneous language samples collected across two times of assessment, approximately one year apart. Additionally, this study examined the robustness of the EOI account to examinations of homophonous forms with different underlying syntactic representations in English, with comparisons made to the surface account.

Regular Past Tense Accuracy

In order to make meaningful comparisons between the regular past tense and the regular past participle, the validity of the regular past tense results needed to be established. According to the EOI account, because children with SLI demonstrate a particular weakness in finiteness marking, they will not perform at age expectations on the regular past tense. An analysis of regular past tense accuracy demonstrated that the AE group was more accurate at Time 1 and Time 2 compared to the SLI group. The SLI group and the LE group performed similarly at both times of assessment. Also as expected, accuracy on the regular past tense increased significantly for both the SLI group and the LE group from Time 1 to Time 2. The pattern of results observed for the regular past tense is consistent with results reported previously.

Importantly, the EOI account predicts errors of omission to be the primary error in finiteness-required sites. While the AE group performed near ceiling on the regular past tense, the SLI group and the LE group exclusively made errors of omission. Based on the pattern of

accuracy levels and errors observed, meaningful comparisons could be made between the regular past tense and the regular past participle.

Irregular Past Tense Accuracy

Likewise, to make meaningful comparisons between the irregular past tense and the irregular past participle, the validity of the irregular past tense results needed to be established. As with the regular past tense, the EOI account predicts that children with SLI will not perform at age expectations on the irregular past tense. Recall that under the EOI account, accuracy on the irregular past tense can be evaluated two ways: 1) by requiring the morphophonologically correct form, and 2) by relaxing the morphophonological requirement to allow for overregularizations to be counted as attempts at finiteness marking. An analysis of irregular past tense accuracy demonstrated that the AE group was more accurate compared to the SLI group at Time 1 and Time 2 and the LE group at Time 1 irrespective of how accuracy was evaluated. However, when the morphophonologically correct form was required, the AE and LE groups did not significantly differ in accuracy at Time 2. Also as expected, accuracy on the irregular past tense increased significantly for both the SLI group and the LE group from Time 1 to Time 2, irrespective of how accuracy was evaluated. The pattern of results observed for the irregular past tense is consistent with results reported previously.

The EOI account predicts errors of omission to be the primary error in finiteness-required sites. It also takes morphophonologically incorrect forms (i.e., overregularizations) to be attempts at finiteness-marking. Recall that overregularizations were initially counted as overt errors (see Table 5 and Table 6). However, when overregularizations (see Table 7) were not included in the count of overt errors, omissions for all groups were the primary error. Notice that as the proportion of errors (omissions + overt errors) decreased for the SLI group, the proportion

of overregularizations increased. Thus, based on the pattern of accuracy levels and the pattern of errors observed, meaningful comparisons could be made between the irregular past tense and the irregular past participle.

Regular Past Participle Accuracy

Although the EOI account predicts that children with SLI will not perform at age expectations on the past tense, it does not predict a difference in performance on the regular past participle as morphophonology (i.e., surface form) is not predicted to affect accuracy. However, both the AE group and the LE group were more accurate at Time 1 compared to the SLI group, which is not explicitly predicted by the EOI account. At Time 2, the groups did not differ; however, from Time 1 to Time 2, accuracy on the regular past participle increased significantly for the SLI group.

Past participle errors are outside the scope of the EOI account; however, errors of omission were the primary error for the regular past participle for all groups. For the SLI group, the proportion of regular past participle omissions decreased from 23.3% at Time 1 to 10.6% at Time 2. Note that the proportion of regular past tense omissions decreased from 44.2% at Time 1 to 19.6% at Time 2. This indicates that, while the SLI group did not perform at age expectations at Time 1 on the regular past participle, they were sensitive to the morphosyntactic differences between the regular past tense and the regular past participle as evidenced by differing omission rates.

Recall that the mean age of the SLI group in Leonard et al. (2003) was 5;6 and the mean age of the SLI group in Redmond (2003) was 6;1. These mean ages roughly correspond to the mean ages of the SLI group in this study at Time 1 (M = 5;5) and Time 2 (M = 6;6). In Leonard et al. (2003), the SLI group was less accurate compared to both the AE group and the LE group

on the regular past participle. Contrastingly, in Redmond (2003), the SLI group did not differ from the AE group and the LE group. The overall pattern of results from the current study are consistent with the results from both Leonard et al. (2003) and Redmond (2003). That is, group differences depend on the age at which testing is completed, highlighting the importance of age at time of assessment when examining performance levels on different dimensions of language.

Irregular Past Participle Accuracy

Just as with the regular past participle, the EOI account predicts that children with SLI will perform at age expectations on the irregular past participle. Note that this prediction is made irrespective of differences between irregular past tense and irregular past participle forms (refer to Table 1). Irregular past participle accuracy, like accuracy on the irregular past tense, was evaluated two ways: 1) by requiring the morphophonologically correct form, and 2) by relaxing the morphophonological requirement to allow for overregularizations to be counted as attempts at irregular past participle inflection. An analysis of irregular past participle accuracy demonstrated that the groups did not differ at Time 1, irrespective of how accuracy was evaluated. However at Time 2, when the morphophonologically correct form was required, the SLI group was more accurate compared to the LE group, but not the AE group. The AE group also did not differ from the LE group. After relaxing the morphophonological requirement, the groups did not differ in accuracy at Time 2.

Note that when the morphophonologically correct form was required, the AE group and the SLI group performed similarly at Time 1 and Time 2, but accuracy on the irregular past participle decreased significantly for the LE group from Time 1 to Time 2. A possible explanation for the LE group's decrease in performance concerns their narrow use of irregular past participles at the first time of assessment. For example, at Time 1, the LE group primarily

used the irregular past participles, *done*, *gone*, and *stuck*. These three irregular past participles comprised approximately 85% of the correctly used irregular past participles for the LE group at Time 1. However, at Time 2, *done*, *gone*, and *stuck* only comprised approximately 35% of the correctly used irregular past participles for the LE group. As a group, while simultaneously broadening their range of irregular past participles attempted, their number of irregular past participle errors increased. However, when the morphophonological requirement was relaxed, the LE group performed similarly at Time 1 and Time 2.

Irregular past participle accuracy was not assessed in Redmond (2003); however, irregular past participles with the *–(e)n* inflection were included in Leonard et al. (2003) as a methodological control, as discussed previously. Leonard et al. found no significant difference in irregular past participle accuracy between their SLI group and LE group. Similarly, in the current study, there was no significant difference in accuracy on the irregular past participle between the SLI group and the LE group at Time 1.

As previously stated, past participle errors are outside the scope of the EOI account; however, errors of omission were the primary error for the irregular past participle for the SLI group and the LE group at Time 1. At Time 2, overregularization errors were the primary error for both groups. However, note that accuracy levels are high for the SLI group at both times of assessment. The surface account predicts that irregular forms will not be problematic, which is consistent with the SLI group's performance.

Regular Past Tense v. Regular Past Participle (SLI Group)

Although the EOI account predicts a dissociation in performance levels between the regular past tense and the regular past participle as children with SLI are predicted to be more accurate on the regular past participle, the surface account predicts no such dissociation in

performance levels. An analysis comparing regular past tense accuracy to regular past participle accuracy for the SLI group demonstrated that the SLI group was more accurate on the regular past participle at Time 1, but not Time 2. Although, performance was relatively high on both regular forms at Time 2.

Recall that the mean age of the SLI group at Time 1 roughly corresponds to the mean age of the SLI group in Leonard et al. (2003) where the SLI group was also more accurate on the regular past participle compared to the regular past tense. A direct comparison between accuracy on the regular past tense and the regular past participle was not explicitly made in Redmond (2003). However, Redmond took the dissociation in performance levels between the regular past tense and the regular past participle as evidence that children with SLI have difficulties with regular past tense affixation, but not regular past participle affixation. Thus, results comparing accuracy on the regular past tense and regular past participle are consistent with what has been reported previously.

Irregular Past Tense v. Irregular Past Participle (SLI group)

Unlike previous studies, the current study also explicitly compared accuracy on the irregular past tense to accuracy on the irregular past participle. Similar to the regular past tense and regular past participle comparison, the EOI account predicts a dissociation in performance levels as children with SLI are predicted to be more accurate on the irregular past participle, while the surface account predicts no such dissociation in performance levels. An analysis comparing irregular past tense accuracy to irregular past participle accuracy for the SLI group demonstrated that the SLI group was more accurate on the irregular past participle at both Time 1 and Time 2, irrespective of how accuracy was evaluated. These results are consistent with

those reported for the regular past tense and the regular past participle, which demonstrate that the past tense is more challenging than the past participle for children with SLI.

Accounts of Past Tense Performance

By comparing accuracy on the past tense to accuracy on the past participle, this study also tested the robustness of the EOI account to examinations of homophonous forms with different underlying syntactic representations in English. To review, the EOI account predicts that children with SLI will show weaknesses in finiteness marking, but not in nonfinite marking of past participles. Thus, the EOI account predicts that children with SLI will be more accurate on the past participle compared to the past tense. The EOI account predicts errors of omission to be the primary error in finiteness-required sites in clauses and, importantly, omissions are restricted to these finiteness-marking sites. As a result, errors of omission on past participle attempts are outside the scope of the EOI account as the EOI account focuses on TNS and AGR checking.

The surface account provides an alternative explanation for the past tense difficulties observed in children with SLI. Specifically, the surface account proposes that children with SLI have a general processing capacity constraint, which affects their ability to perceive grammatical morphemes (Leonard et al., 1997). The surface account predicts that children with SLI will have a relative difficulty with brief morphemes and that their limited general processing capacity will be especially challenged when such brief morphemes "play a morphological role" (Leonard et al., 1997). Like the EOI account, the surface account predicts errors of omission, but only for regular past tense verbs. Importantly, omissions are not limited to finiteness-marking sites in clauses. Irregular verbs are not predicted to be problematic for children with SLI as irregular past tense forms differ from irregular present tense forms "at least in a stressed vowel" (e.g., thr*o*w –

thr*e*w) (Leonard et al., 1997). Importantly, the surface account does not predict a dissociation in performance levels between the regular past tense and the regular past participle. A clear prediction is not made for the irregular past tense and irregular past participle comparison, but a prediction of no dissociation in performance is likely.

As predicted by the EOI account, the past tense was more difficult than the past participle for SLI children, irrespective of form. For the regular past tense and regular past participle comparison, the SLI group was more accurate on the regular past participle at Time 1, but not at Time 2. For the irregular past tense and irregular past participle comparison, the SLI group was more accurate on the irregular past participle at both Time 1 and Time 2.

Not explicitly predicted by the EOI account was the result that at Time 1, the AE group and the LE group were more accurate on the regular past participle compared to the SLI group. Although this finding is not specifically predicted by the EOI account, it is compatible with it and can be explained by a potential interference between the morphophonological form and the underlying morphosyntactic representation. However, recall that the SLI children were able to readily distinguish the two homophonous forms as evidenced by differing omission rates. In Leonard et al. (2003), this difference in performance on the regular past participle between the SLI group and the LE group is discussed and they take the difference to be consistent with the surface account. Specifically, the surface account "holds that children with SLI will lag behind [the LE group] in the use of any grammatical morpheme possessing brief duration" (Leonard et al., 2003). However, at Time 2, the groups did not differ on the regular past participle. Such a result is not necessarily problematic for Leonard and colleagues' explanation; however, their explanation would need to be revised to include some other developmental factor.

As predicted by the EOI account, the SLI group also met age expectations for the irregular past participle at both Time 1 and Time 2, irrespective of how accuracy was evaluated. In fact, the SLI group outscored the AE group at Time 2, although this difference was not significant for either irregular past participle analyses. Interestingly, the LE group's irregular past participle accuracy significantly decreased from Time 1 to Time 2 when the morphophonologically correct form was required, which is not explicitly predicted by either the EOI account or the surface account, but can be explained by their increasing range of irregular past participles attempts. Such a result requires further exploration into the development of irregular past participles over time. However, the LE group's outcomes are consistent with earlier reports that young children are likely to rely on General All-Purpose (GAP) verbs (cf. Rice & Bode, 1993; Watkins, Rice, & Moltz, 1993). When the morphophonological requirement was relaxed, there were no group differences across groups on the irregular past participle at either time of assessment. Such a difference in performance for the LE group should be explored further.

Finally, as predicted by the EOI account, errors of omission were the primary error for the regular past tense. Errors of omission were also the primary error for the regular past participle. For the irregular past tense, the SLI group primarily made errors of omission while the LE group moved from primarily making errors of omission to making overregularization errors. For the irregular past participle, both the SLI group and the LE group primarily made errors of omission at Time 1; however, at Time 2, both groups made proportionally more overregularizations errors.

Errors of omission for the regular past tense and the regular past participle are also compatible with the surface account; however, the surface account makes no such prediction for

the irregular past tense and the irregular past participle. While the EOI account is able to explain the observed error patterns, the surface account cannot explain the observed error patterns for irregular forms, nor the dissociation in performance between the regular past tense and the regular past participle.

Limitations

Although previous studies largely, if not exclusively, relied on data from elicitation probes, data for the current study came from spontaneous language samples. As a result, a wide range of attempts were made across the four forms during the two times of assessment. To be scored for any one of the four forms, at least two attempts needed to be made at the first time of assessment on one of the forms. Because of this, a number of children were not included in any one comparison with the most children ineligible to enter into the past participle comparisons. However, by including the criterion of at least two attempts, children's accuracy was measured on at least a three-point scale at the first time of assessment, increasing the validity of the results.

Also, because data solely came from spontaneous samples, it was not possible to directly compare specific pairs of past tense and past participle verbs. For example, comparisons of same and different irregular past tense and irregular past participle forms (e.g., Henry *met* the cat *v.* Henry *had met* the cat; Henry *ran* home *v.* Henry *had run* home) could explicitly test predictions of the surface account based on different morphemes. Future research should aim to assess accuracy on present tense, past tense, and past participle forms simultaneously. For example, children may have particular difficulties with specific classes of irregular verbs.

Finally, although accuracy on regular and irregular past tense and past participle verbs was examined in this study, children's accuracy on zero-change/no-change past tense and past participle verbs (e.g., cut, hit, hurt) was not examined. The exclusion of these kinds of verbs is

actually a strength of the current study as such verb forms could enter into the analysis and inflate the accuracy levels. Consider:

(26) They *cut* the paper. (present tense)

(27) They *cut* the paper. (past tense)

(27) They had *cut* the paper. (past participle)

Because each form of *cut* is morphophonologically the same irrespective of syntactic position, it would be difficult to evaluate children's knowledge of morphosyntax. Errors of omission are not possible as the base form remains unchanged with the exception of the third person singular present tense (i.e., *cuts*).

Summary and Conclusions

Results from this study demonstrate that for children with SLI, the past participle is easier than the past tense, with the irregular past participle conferring an even greater advantage than the regular past participle. Along these lines, most informative was the finding from the regular past participle analysis that the SLI group, while significantly less accurate compared to both the AE and the LE group at Time 1, did not significantly differ in accuracy from either group at Time 2. Thus, homophonous forms have different accuracy levels for SLI children, attributable to the finiteness function of morphosyntax.

Results from the regular past tense and regular past participle comparison also highlight the importance of age at time of assessment. This study demonstrated that what was perceived to be an inconsistency in the literature is actually a result of a meaningful difference in mean ages for different SLI groups across studies. That is, by evaluating accuracy across the age range at two times of assessment, more precise groupings could be made to clarify what was going on in the age ranges of the previous studies. Bridging the gap between different outcomes was only

possible by employing a longitudinal design. Importantly, in this age range, the SLI group and the LE group improved their levels of performance, and their use of overregularized forms is indicative of their developing abstract representations of morphophonology.

The observed errors patterns for the regular and irregular past participle also highlight the need to further investigate the source of the errors for both the SLI group and the LE group. Results from the regular past participle analysis at Time 1 suggest that there may be other requirements in the clause affecting the SLI group's accuracy. Results from the irregular past participle analysis at Time 2 for the LE group similarly suggest that there may be some other requirement in the clause affecting accuracy for typically developing children. Recall that when the morphophonological requirement was relaxed for the irregular past participle, the LE group's accuracy did not significantly differ from the SLI and AE groups. The use of overregularized irregular past participles requires further investigation.

Finally, this study also examined the robustness of the Extended Optional Infinitive account to examinations of homophonous forms with different underlying syntactic representations in English-speaking children with SLI, with comparisons made to the alternative surface account. Results from the current study support the EOI account's prediction that children with SLI's difficulty with the past tense is attributable to the finiteness requirement in the TNS/AGR slot in a clause and this phenomenon, in general, does not hold for other elements in a clause without a TNS/AGR slot that use the same lexical verbs. That is, children with SLI show weaknesses in finiteness marking, but not to the same degree in nonfinite marking of past participles. Thus, observed difficulties are more about the grammatical function of finiteness than surface form processing demands.

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Appendix A

Morphophonological Requirement Model[2]

Proportion correct under morphophonological scoring rules was modeled with Stata *xtmixed*. The model entailed fully factorial level-1 fixed effects (i.e., 3 groups * 2 occasions * 4 language forms = 24 parameters), no level-2 fixed effects, and a random intercept parameter to address dependencies due to repeated measurements within subjects. To maximize comparability with previously published work, proportions were modeled as continuous with normally distributed residuals (i.e., link=Identity, family=Normal). However, examination of alternative generalized models (i.e., link=Logit, family=Binominal) evidenced that these data were very robust to violation of normality assumptions.

Parameter/Statistic	**Est.**	**SE**	**[95% CI]**	
Fixed Level 1 Effects[a]				
(Group / Time / Form)				
Specific Language Impaired (SLI)				
1				
Regular Past Tense	0.5559	0.0294	0.4982	0.6136
Irregular Past Tense	0.6634	0.0280	0.6086	0.7183
Regular Past Participle	0.7504	0.0362	0.6794	0.8213
Irregular Past Participle	0.9001	0.0362	0.8292	0.9711
2				
Regular Past Tense	0.8002	0.0300	0.7415	0.8589
Irregular Past Tense	0.7920	0.0280	0.7372	0.8469
Regular Past Participle	0.8917	0.0390	0.8153	0.9680
Irregular Past Participle	0.8915	0.0403	0.8125	0.9704
Age Equivalent Controls (AE)				
1				
Regular Past Tense	0.9347	0.0303	0.8753	0.9940
Irregular Past Tense	0.9458	0.0287	0.8896	1.0021[3] [b]
Regular Past Participle	0.9902	0.0344	0.9227	1.0577
Irregular Past Participle	0.8420	0.0452	0.7534	0.9305
2				
Regular Past Tense	0.9718	0.0312	0.9107	1.0329
Irregular Past Tense	0.9618	0.0287	0.9056	1.0181
Regular Past Participle	0.9846	0.0358	0.9145	1.0547
Irregular Past Participle	0.8355	0.0462	0.7451	0.9260

[2] Note: Regular and irregular form (morphophonological requirement) comparisons were made using this model.

Language Equivalent Controls (LE)				
1				
Regular Past Tense	0.5538	0.0428	0.4699	0.6377
Irregular Past Tense	0.6479	0.0387	0.5721	0.7237
Regular Past Participle	0.9348	0.0684	0.8007	1.0690
Irregular Past Participle	0.9221	0.0512	0.8217	1.0226
2				
Regular Past Tense	0.8996	0.0445	0.8124	0.9868
Irregular Past Tense	0.8111	0.0387	0.7353	0.8869
Regular Past Participle	0.9652	0.0764	0.8154	1.1150
Irregular Past Participle	0.6990	0.0580	0.5853	0.8126
Fixed Level 2 Effects -(none)-				
Random Effects				
Between Subject Variance	0.0045	0.0016	0.0022	0.0090
Within Subject (Residual) Variance	0.0434	0.0023	0.0390	0.0482
ICC	0.0934			
Psuedo R^{2c}	27.32%			
LL	95.136			
Level 2 Groups	156			
Level 1 Observations	856			
Obs per group				
min	2.0			
avg	5.5			
max	8.0			

[a] A fully factorial model (i.e., 24 = 3 * 2 * 4) was estimated. However the corresponding 24 marginal means are tabulated here for ease of interpretability.

[b] Estimated proportions can exceed 1.0 because the identity link does not constrain estimates to be between 0 and 1; however actual performance cannot exceed 1.00 (i.e., 100%).

[c] Pseudo R2 value obtained via the correlation of model based predictions and actual performance.

Appendix B

Relaxed Morphophonological Requirement Model[4]

Proportion correct under relaxed morphophonological scoring rules was modeled with Stata *xtmixed*. The model entailed fully factorial level-1 fixed effects (i.e., 3 groups * 2 occasions * 4 language forms = 24 parameters), no level-2 fixed effects, and a random intercept parameter to address dependencies due to repeated measurements within subjects. To maximize comparability with previously published work, proportions were modeled as continuous with normally distributed residuals (i.e., link=Identity, family=Normal). However, examination of alternative generalized models (i.e., link=Logit, family=Binominal) evidenced that these data were very robust to violation of normality assumptions.

Parameter/Statistic	**Est.**	**SE**	**[95% CI]**	
Fixed Level 1 Effects[a]				
(Group / Time / Form)				
Specific Language Impaired (SLI)				
1				
Regular Past Tense	0.5531	0.0273	0.4996	0.6067
Irregular Past Tense	0.7428	0.0260	0.6918	0.7938
Regular Past Participle	0.7521	0.0335	0.6866	0.8177
Irregular Past Participle	0.9264	0.0335	0.8608	0.9919
2				
Regular Past Tense	0.7972	0.0278	0.7427	0.8517
Irregular Past Tense	0.8791	0.0260	0.8281	0.9300
Regular Past Participle	0.8945	0.0360	0.8240	0.9650
Irregular Past Participle	0.9700	0.0371	0.8973	1.0428[5] [b]
Age Equivalent Controls (AE)				
1				
Regular Past Tense	0.9348	0.0281	0.8796	0.9899
Irregular Past Tense	0.9737	0.0267	0.9214	1.0261
Regular Past Participle	0.9900	0.0319	0.9276	1.0525
Irregular Past Participle	0.9044	0.0416	0.8228	0.9860
2				
Regular Past Tense	0.9718	0.0289	0.9151	1.0285
Irregular Past Tense	0.9791	0.0267	0.9268	1.0314
Regular Past Participle	0.9840	0.0331	0.9192	1.0489
Irregular Past Participle	0.8867	0.0425	0.8033	0.9700

[4] Note: Only relaxed morphonological form comparisons were made using this model.

Language Equivalent Controls (LE)				
1				
Regular Past Tense	0.5542	0.0397	0.4764	0.6320
Irregular Past Tense	0.7751	0.0359	0.7047	0.8456
Regular Past Participle	0.9207	0.0630	0.7972	1.0443
Irregular Past Participle	0.9495	0.0474	0.8566	1.0423
2				
Regular Past Tense	0.9026	0.0412	0.8218	0.9834
Irregular Past Tense	0.9343	0.0359	0.8638	1.0047
Regular Past Participle	0.9458	0.0703	0.8080	1.0836
Irregular Past Participle	0.9142	0.0535	0.8094	1.0190
Fixed Level 2 Effects -(none)-				
Random Effects				
Between Subject Variance	0.0056	0.0016	0.0033	0.0098
Within Subject (Residual) Variance	0.0357	0.0019	0.0321	0.0397
ICC	0.1365			
Psuedo R^{2c}	28.07%			
LL	165.702			
Level 2 Groups	156			
Level 1 Observations	856			
Obs per group				
min	2.0			
avg	5.5			
max	8.0			

[a] A fully factorial model (i.e., 24 = 3 * 2 * 4) was estimated. However the corresponding 24 marginal means are tabulated here for ease of interpretability.

[b] Estimated proportions can exceed 1.0 because the identity link does not constrain estimates to be between 0 and 1; however actual performance cannot exceed 1.00 (i.e., 100%).

[c] Pseudo R2 value obtained via the correlation of model based predictions and actual performance.